

IPSC Comments

B&W Analysis of Intermountain Power Project Steam Generators

1. A significant portion of our reasoning to have B&W complete the analysis on our boilers was the prospect of reviewing the results from an accurate boiler model. We are still anticipating the numerical, detailed results of that model (@ 6.9MMlb/hr turbine throttle flow) within the final report. Among these parameters would be the following:
 - Furnace exit gas temp design vs. model
 - Correlation of furnace exit gas temps with ash softening temps
 - Numerical impact of tube shields on RH and EGOT
 - Kf factors used in each section
 - Results of primary superheat absorption analysis (standard margins, etc.)
 - Anticipated increase in feed pump head requirements
 - Gas velocity recommended limits to compare with existing and uprate velocity table
 - Anticipated attemperator spray flows at 30%, 50% and 75% load
2. We would like to discuss the reasoning behind the proprietary policy on design tube metal temperatures. This information is a key concept in maintaining appropriate operating margins throughout the boiler and provides valuable inspection and testing guidance in our boiler reliability maintenance program.
3. We were also hoping for some analysis of the potential to build and remove clinker in the superheat areas at the new loads. We have already had some concern in this area. We have recently installed several new blowers to assist in addressing this issue.
4. Are our current drum level balance concerns the result of the fact that we are not within the required flow unbalance limits?
5. As we have discussed we need the recommended setpoint for the new main steam safety relief valve and the new setpoints for the reheat safety relief valves with the new springs.
6. We were hoping for more detail on the proposed new burner register design. (Sizes, general arrangement, economics, etc.)
7. I hope we haven't mislead you regarding PA fan high speed operation but we seldom have had to take our PA fans to high speed at the current load point. The only reason we have run high speed on these fans is due to abnormalities in fuel quality or high differential concerns within the mills.
8. We appreciate the air curve shown for rotating throats. We would appreciate the same type curve for our stationary throats as well.

9. There is some confusion regarding the PA duct pressure comments. The performance people here are adamant that we have actually increased PA duct pressure over the years to keep the mills from loading up. This has, of course, noticeably increased PA Heater leakages.
10. There appears to be little treatment of the identified concerns regarding our attemperation configuration (i.e. primary stage/second stage swapped).
11. Please discuss the anticipated affects throughout the boiler of correcting our bias damper load/position control curves. (i.e. any affect on reheat sprays, reheat temp control, etc.)
12. One of the observations noted that it appeared that reheat temperatures are intentionally kept low to minimize high transients. Even if this was the case at the time of the B&W on-site observations, the far greater concern to Operations is with their ability, especially with the uprate, to maintain required reheat temperatures.

As we have discussed, we do expect some simultaneous advantage with reheat temperature support by installing the additional PSH surface. Operations still, however, is not only concerned about reheat temperature support at existing full load but is much more concerned about reheat temperature support at the new load points.

13. Finally, on your conclusions and recommendations page (40) we would appreciate as much detail in your recommendations list as possible.

Note to Purchasing:

Answers to several questions that were resolved in a talk with the vendors:

1. Bergemann shall provide and install retractable cord reels in place of the 'e-chain' design power cord assemblies on all blowers. The retractable cord reels are identified by model number within the specification. All support framing associated with the 'e-chain' design will also be removed.
2. Delivery of the wall tube panel sections is 9-10 weeks
3. Delivery of the blowers can be achieved within the 15 weeks remaining until the outage.
4. Bergemann has offered to increase the on-site installation technical direction from 2 days to 4 days per unit to cover installation and checkout of all 6 blowers.
5. Bergemann shall ensure that all Bergemann lances are interchangeable with the existing B&W lances both on the superheat and reheat blowers. The superheat and reheat blower lances are each of different dimensions.
6. Bergemann supplied spare part offer means that they will consign any required parts to us for the duration of the warranty. Following the warranty IPSC will be required to purchase any required parts.
7. Bergemann shall provide dimensionalized drawings of the blowers supplied showing elevation dimensions of the blowers in both standard and droop corrected designs.
8. Lances shall be manufactured entirely of ASTM A519 (B&W 6330) material.
9. Bergemann will provide wiring schematics for all wiring between the blower and the local starter cabinet within two weeks of award.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: S. Gale Chapman
FROM: Dennis K. Killian
DATE: December 13, 2000
SUBJECT: Boiler Feed Pump and Turbine Uprate

In accordance with recent approvals from staff, the boiler feed pump turbine high speed stop setpoint has been increased from 5750 rpm to 6000 rpm on Unit 2 only. The identical setpoints on Unit 1 will be modified during the upcoming spring outage.

Boiler feed pump turbine back-up overspeed setpoint has been adjusted to allow for 6000 rpm high speed stop operation. A flow increase of approximately 150,000 lbs/hr per pump is anticipated at 6000 rpm.

Analysis and consent from both the original boiler feed pump turbine manufacturer and the pump manufacturer is available upon request. Contact James Nelson at Extension 6464 with comments or questions.

JHN/JKH:db

CC: George Cross

IP12_003459

Boiler Uprate

Update for Coordinating Committee

In May of 2001 a study was commissioned from Babcock & Wilcox, the IGS boiler manufacturer, to provide recommendations for any required modifications for uprating the IGS boiler flow by approximately 5%. This study is nearing conclusion. The preliminary results from this study are confirming earlier estimates that the IGS boilers have adequate design margins in most every area.

The scope of the study includes the evaluation of all aspects of boiler operation including:

- Gas side operational analysis
- Steam side operational analysis
- Metallurgical adequacy
- Fuel preparation and handling
- Fan Capacity Review
- Code compliance Review

The analysis was initiated by performing onsite operational testing/tuning and gathering all applicable operating and maintenance data for entry into the B&W Boiler Performance Computer Model. This static thermal computer model was run for the anticipated load points and primary fuels. The model identified areas where modifications may be advisable for improving stability and reliability at the higher flows.

B&W has so far identified 5 items they consider to be higher priority. These items are all relatively small in scope and cost, they include:

1. Relocation of the Drum Level Sensing Taps:

Relocate all eight instrument taps approximately 10 ft. in from the ends of the drum to provide a more representative indication of drum level.

2. Modification of Drum Belly Baffles:

Extending the drum baffles further up the side walls to encourage proper distribution of the increased flows.

3. Re-orientation of Drum Down Spouts:

A small number of the down spouts will require reorientation to encourage proper distribution of flow within the drum.

4. Modification of One ERV:

Due to historical reliability concerns with existing main steam safety valves, B&W has proposed modifying one to the existing two electromechanical relief valves to mechanical spring operation. This will maintain valve redundancy at the higher loads.

5. HRH and CRH Safety Valve Setpoint Change:

The current setpoints on the hot reheat and cold reheat safety relief valves will be increased. This will likely require replacement of the actuation spring in each valve.

B&W has also proposed that as a secondary priority, it may also be wise to consider increasing the primary superheater surface area to provide greater superheater and reheater outlet temperature control and stability at the higher loads. B&W is not identifying this modification to superheater surface area as a prerequisite to the uprate, however, the model shows that outlet temperatures during mill trips and various sootblowing configurations would be significantly more stable with the increase in surface.

Wide variations in superheat outlet temperatures are primarily a concern in thermal fatigue of the boiler internal and external high energy piping. IPSC is currently evaluating this secondary proposal for cost effectiveness.

Conclusion of the study and issuance of the final report is scheduled for September 3, 2001. Any recommendations from the study that are subsequently approved, will be scheduled for installation during the spring outages of 2003 and 2004 in the respective units. Funds for these modifications will be identified within the applicable capital budgets for those years.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross

Page 1 of 1

FROM: Dennis K. Killian

DATE: January 4, 2011

SUBJECT: Award of Boiler Model Contract to GE/EER

We recommend award of the boiler modeling contract to GE Energy and Environmental Research Corporation. Of the three bids solicited only two were received. Of these two, GE was the lowest cost and the only responsive bid.

The attached IPSC specification and offering package from GE covers the key aspects of both the gas side (CFD) model for prediction of combustion performance and emissions considerations, and a thermal model for prediction of steam side performance. The models will be executed at various loads including verification of existing operation and the new full load level of 950 MW.

A focus of this model will be the verification of the proposed boiler modifications design by Babcock Borsig. The contract with Babcock Borsig details the requirements for Borsig to provide all required design geometric and performance data to the Modeling Engineer for verification of design adequacy. Borsig is required to reconcile and/or accommodate all concerns raised by the Modeling Engineer within the Borsig design.

GE/EER has considerable experience in both design and retrofit of combustion technologies into existing steam generators. There are a number of adjustments to Borsig's original design which could be implemented during fabrication or installation if so desired. At the very least the model would provide valuable input for system adjustment and operational guidance for combustion optimization. Indicate your approval by signing below.

Dennis K. Killian
Supt. of Technical Services

George W. Cross
President & COO

JHN:jmg
Attachments

IP12_003462



INTERMOUNTAIN POWER SERVICE CORPORATION

Station Uprate Operational Guidance Manual

B. Boiler Modifications

Project Overview

Modifications to the boiler include both capacity provisions for achieving the 950 MWg target and performance enhancements for improved operational stability.

The modifications are as follows:

- Platen Superheater Extension
- Overfire Air Addition (OFA)
- Drum Flow Distribution and Level Indication Stability Modifications
- Main Steam and Reheat Safety Relief Valve Additions and Re-rates

The platen extensions constitute an approximate 10% increase in the overall platen superheater surface area. This increase in surface area yields an increase in platen energy absorption of nearly 13%. Steam temperature targets have not changed with these modifications. Platen superheat is being added specifically to allow more flexibility and stability in maintaining steam outlet temperature without losing boiler performance. In redistributing the energy absorption within the boiler, the increase superheat surface will restore valuable attemperatur spray flow margins to provide better control of steam temperatures at the new full load flows. No changes in operating procedures are anticipated in connection with the platen surface addition.

The OFA system is being provided to allow for greater operational flexibility while meeting or exceeding emissions criteria, under varying fuel and load conditions. Performance guarantees associated with LOIs, carbon monoxide and steam temperature will be verified during a boiler performance test in late April, 2003.

At the new design, VWO full load flow of 6.9 MMlb/hr the OEM (Babcock & Wilcox) had concerns regarding proper flow distribution within the drum. We also investigated ways of stabilizing drum level indication throughout the load range. As a result, a few small internal modifications will be made to drum internals.

Finally, in keeping with the new full load design flow rating of the boiler, the electromatic relief valve previously know as ERV #3 will now be replaced with a mechanical relief valve similar to the existing main steam safety relief valves #5 and #6. The new valve will be known as Main Steam Safety Relief Valve #4.

Initial Startup Issues

Control adjustments to the overfire air system are expected during the initial ascent to full load. During the first week of operation, while turbine balance and overspeed issues are being addressed, technical support personnel from BPI Inc., the OFA designers will be on-site to assist ES in optimizing the OFA system.

Startup screens are being placed in the turbine stop valves and the BFPT main steam stop valves to protect this equipment from solid particles that were not removed in the boiler component cleaning phase prior to installation. Tentative plans call for a short unit outage after approximately one week of operation to remove all startup screens.

Operational Guidelines

The OFA system is designed to operate without the need for constant operator attention. Control of combustion air flows and overfire air flows will be maintained within the existing CCS system. Manual control is available at all times.

The operational interface with the OFA system will consist of three Videospec screens.

1. The first screen will display both current system operational parameters (i.e. flow, temperatures, etc.) and provide master control of the OFA system.
2. The second screen will allow control of the 1/3 and 2/3 port dampers.
3. The third screen allow control of the new OFA compartment dampers (4 ea.)

In accordance with OEM specifications the OFA port dampers will be controlled as follows:

<u>Load</u>	<u>Port Dampers</u>	<u>Compartment Dampers</u>
0-60%	None	5% Open (port cooling)
60% - 75%	1/3 dmpr. open, 2/3 dmpr. closed	Open
75% - 90%	2/3 dmpr. open, 1/3 dmpr. closed	Open
90% - 100%	All open	Open

(Modifications to this guideline will likely be forthcoming as CO emissions and unburned carbon levels are verified in operational testing.)

The OFA system consists of the addition of 16 ports in the furnace directly above the top row of burners, (9th level). Eight ports installed in the front wall and eight in the rear wall. These ports will each be designed with parallel 1/3 and 2/3 dampers. Each of the two rows of ports will be outfitted with windbox compartment dampers at each end of the respective windbox compartment.

The OFA system extracts a portion of the combustion air normally fed into the existing burner windbox compartments. The percent of total combustion air fed into the OFA compartment is determined by FD fan output and the degree to which the combustion air flow is restricted at the existing burner levels.

Incrementally increasing the air flow into the OFA system, under nominal conditions, should be expected to decrease CO emission levels. Incrementally decreasing air to the burner levels should be expected to decrease NO_x emissions levels but increase LOI levels. Proper operation of the OFA system will consist of a balance in these factors. Overall, the goal will be to keep the NO_x emission levels at or below 0.37 lbs/MMBTU on a 30 day rolling average basis without unacceptably affecting unburned carbon percentages. Adjustments to OFA operating parameters will likely be required with the anticipated changes in fuel chemistry/sources.

Within the first two weeks of operation, the OFA system will be monitored and tuned for stable operation throughout the turbine testing period. At approximately 5-6 weeks after startup, a full boiler optimization test will occur. During this testing, performance parameters associated with contract guarantees will be verified and further control adjustments will be made in accordance with operating experience.

The location of the new OFA system feeder ducts will now obstruct access to the sides of the furnace from the 9th level. Access to furnace equipment located between the new OFA feeder ducts, such as the boiler cameras, will now be accomplished from stairways installed at the eighth level crosswalks on each side of the furnace. Provisions are underway to assist operators with periodic boiler camera cleaning, as cleaning access through boiler corner ports will now be unavailable.

All dampers, four (4) each compartment dampers and eight (8) each port (1/3, 2/3) dampers will be actuated and remotely operable from the main control panel. OFA compartment air flow will be sensed at each end of both OFA compartments (front and rear). Indication of compartment air flow and damper position control blocks will be displayed on the main control panel on a videospec screen built specifically for OFA system control. Additionally, differential pressure (flow) instruments will be provided at the throat of each OFA port at local displays. These port flow indicators will be used primarily for side to side, on-line balancing of OFA port flows.

The modifications made to the drum are expected to improve drum level reliability and consistency. Several of the downspouts have been redirected to distribute condensate flow more evenly throughout the drum. Also the drum level sensing taps have been moved further to the outer ends of the drum. These changes should ensure more stability in drum levels indications during transient operation, especially at higher loads.

With the installation of one additional main steam safety valve the new nameplate flow rating on the boiler will be 6.9MMlbs/hr. With this additional valve we are maintaining the redundancy previously existing in the main steam safeties at the new full load steam flow rating of approximately 6.65MMlbs/hr. At this new full load flow rating any one of safety relief valves #4, #5 or #6 can be removed from service without affecting full load capacity. The safety relief valves settings will hereafter be as follows:

<u>Valve #</u>	<u>Old Set Pressure (psia)</u>	<u>New Set</u>
<u>Pressure(psia)</u>		
1SGG-RV4(new)	NA	2855
1SGG-RV5	2815	2835
1SGG-RV6	2800	2815
1SGG-RV7	2785	2795
1SGG-RV8	2775	2775
1SGJ-RV1	681	750
1SGJ-RV2	681	750
1SGJ-RV3	692	755
1SGJ-RV4	692	755
1SGJ-RV5	700	760
1SGJ-RV6	700	760
1SGJ-RV7	705	770

1SGJ-RV8	705	770
1SGJ-RV9	630	698
1SGJ-RV10	630	698
1SGJ-RV11	640	720
1SGJ-RV12	640	720

The actual full load steam flow will be a function of the new HP section efficiency and will be established during the Unit 1 performance testing within the month of April. Unit 2 full load flow was tested at approximately 6.65 MMlbs/hr.

Unit 2 Platen Surface Evaluation

Operational Information

Evaluation of operating modes prior to and since the Unit 1 Boiler modifications is presented here as a basis for the recommendation to reduce the scheduled platen surface extension on Unit 2 in March of 2004.

I. Why Originally Eight Feet?

Three models were commissioned, one of which was a computational fluid dynamic (CFD) model, for the purpose of identifying as closely as possible, the operational impact of overfire air and platen surface additions in Unit 2. All three models predicted a similar low impact on superheat steam temperatures with installation of the eight foot extensions on the platen superheat. The GE EER model, which was the more extensive CFD format, predicted a nominal temperature increase of 6°F at 950MWg. The limiting factor on adding platen surface came from B&W who stated that they did not recommend going below the plane formed by the edge of the bull nose. Eight feet brings the bottom of the platens approximately 3" above the nose.

II. What Impact on Unit 1 Attenuation Requirements Since the Outage?

An average of superheat attenuation sprays for three months prior to the outage compared to three months following the outage are as follows:

<u>Months</u>	<u>Load</u>	<u>Superheat Attenuator Flow</u>
November - February (2002-03)	870MW-880MW	Ave. 63,000 lbs/hr
June - August (2003)	945MW-955MW	Ave.172,000 lbs/hr

III. What Impact on Sootblowing Requirements?

Prior to the 2003 Unit 1 Outage, sootblowing occurred at least twice as often in the pendant sections of the boiler as compared to the furnace areas. Retrieval of archived blowing frequencies since the Unit 1 Outage shows that area blowing frequencies has essentially reversed. The furnace (IR) blowers have been operated at least twice as often as the pendant (IK) blowers. This is indicative of attempts by the unit operator to control excessive outlet temperatures.

IV. Why Choose Four Feet Instead of Eight?

With the dramatic results from the Unit 2 950MW testing in May of 2002, we were originally concerned that eight feet would be insufficient for ensuring superheat temperature stability at full load. B&W has seldom extended superheat surface below the nose of the arch and did not recommend such. Even with the known temperature tendencies of the Unit 2 Boiler we still recommend a degree of additional superheat surface based on the severity of the 2002 testing.

The CFD model prepared by EER confirmed the contentions of the first two empirical models that the predicted result from the eight foot extension would only provide approximately 6°F and approximately 25,000 lbs/hr in superheat attenuation flow. This has not shown to be the case.

Finally, some of the operational assumptions and preferential modes have changed since original design. We now have added reason to encourage higher mass flow (O₂) in the boiler than utilized at the time of the 2002 performance testing, i.e. minimizing both LOIs and CO.

INTERMOUNTAIN POWER SERVICE CORPORATION

X REQUISITION FOR CAPITAL EQUIPMENT

PURCHASE AUTHORIZATION FOR EXPENSE ITEMS

Purpose of Materials, Supplies or Services:

On-site inspection and testing of Unit 1 Boiler by Babcock & Wilcox,
Part of boiler uprate study.

Date: 3/19/01

Req./PA No: 166180

P.O. No:

Vendor:

Terms:

FOB:

Ship Via:

Conf. To:

Suggested Vendor: Babcock & Wilcox
3535 South Platte River Dr
Unit G3, Sheridan, CO 80110

Account No. 1SGA-402
Work Order No. 01-19846
Project No. IGS01-02

Qty	Unit	Description Noun Adjective Catalog # Seller or Manufacturer	Unit Cost	Extension
1	JOB	Inspection and Testing, Boiler. In accordance	\$13,000.00	\$13,000.00
		with the attached rates, schedules and terms from		
		B&W. Inspection shall include up to one full day		
		of internal inspection on Unit 1 Boiler. Testing		
		shall include up to two days of controlled		
		performance monitoring of the Unit 2 Boiler.		
		These inspections and testing are part of the		
		re-rate study to be performed by B&W for		
		increasing boiler output rating on each unit to		
		6.9MMlbs/hr.		
		TOTAL ESTIMATED COST		\$13,000.00

Remarks: Inspection tentatively scheduled for week of March 26.

Delivery requested by [Date] 03/23/01 Originator James H. Nelson

Dept. Mgr/Supt. _____ Date _____ Station Manager _____ Date _____ Operating Agent _____ Date _____

IP12_003469

Intermountain Power Service Corporation
Boiler Uprate Study

Scope of Work

General: The purpose of this study is to provide recommendations covering required physical and operating procedure modifications for increasing boiler rated output by approximately 5%. This uprate is associated with the retrofit of a high performance, high pressure turbine section on both Units 1 and 2.

Scope of Work: The scope of this study shall include a design and operational review of the following items, at a rated boiler output of approximately 6,900,000 lbs/hr steam flow:

1. Furnace circulation system capacity
2. Furnace heat release/absorption capability
3. Steam drum flow handling capacity
4. Boiler metal temperature evaluation and accelerated life consumption estimates
5. Superheat and reheat temperature control and stability design and operational review
6. Operating pressure and pressure drop limitations
7. Safety valve capacity and set pressure design, maintenance and operational review
8. Combustion air and gas flow analysis
9. FD, PA and ID fan capabilities and operational limitations
10. Pulverizer system limitations and performance enhancement recommendations
11. Increased heat input effects on boiler system including burners, ignitors and scanners
12. Boiler tube shielding survey and associated impact on performance
13. Analysis of current combustion practices focusing on NOx reduction and latest NOx technologies

B&W shall assist in the development and execution of two operational tests of at least 4 hour duration each. One of the tests including a full sootblowing cycle. Data from these tests shall form the basis for the computer-based boiler model uprate diagnostics completed by B&W.

B&W shall also participate in one, on-site, off-line inspection, of approximately two days duration, for first hand awareness of current boiler status and for interviewing IPSC personnel regarding operational procedures and concerns.

Products of Study: The product resulting from this study shall consist of a comprehensive written report provided in triplicate to IPSC, within 12 weeks of issuance of a purchase order. The report shall include the following:

- Boiler design modification recommendations
- Estimates for each implementing each recommendation
- Detailed description of each operating procedure recommendation
- Component specific information regarding the calculated effects of the uprate
- All testing data collected throughout the study

Recommendations included within this report shall be confirmed by the collection and consideration of current operating and design data, as well as, implementation of a representative, computer-based, boiler model. B&W retains full responsibility for the correctness and adequacy of any design information provided by IPSC to B&W. B&W should verify all design and operating information provided by IPSC through on-site inspection, performance testing and from within original design files at B&W, prior to use within this study.

Coordination: B&W shall appoint a project manager who shall be responsible to provide weekly updates to IPSC regarding progress of the study, discuss interim concerns on data or preliminary results and coordinate on-site inspections and testing. B&W shall also coordinate their analysis with representatives of other equipment manufacturers designated by IPSC, to ensure operational compatibility among all interfacing systems and equipment.

□ REQUISITION FOR CAPITAL EQUIPMENT

Purpose of Materials, Supplies or Services:

Date: 2/23/01

Req./PA No: 166164

P.O. No:

Vendor: B&W

Terms:

FOB:

Ship Via:

Conf. To:

Account No. 2TGX-101
Work Order No. 01-19846
Project No. IGS01-02

Remarks: _____

Delivery requested by [Date] 03-02-01 Originator James H. Nelson

Dept. Mgr/Supt.	Date	Station Manager	Date	Operating Agent	Date
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IP12 003471

UNIT 1 BOILER MODIFICATIONS COORDINATION

Design/Construct Review Meeting

11/14/02

Agenda

1. Staff Overview (~ 30 min.)

- Organizational Overview
- Design Overview
- Project Schedule Status
- Previous Related Experience

2. Maintenance/Operations Coordination (~2 hrs.)

- Work Scope Review

- Project sequence discussion

- Construction Power Requirements

- Power feeds for welders, lighting, etc. at 14th floor and 9th floor.

- Operation and Control Power at OFA ports

- Power for OFA damper operation

- Control power for damper position feedback and OFA flow signal

- Maintenance Interface

- Staging

- Laydown

- Site and Powerblock Access/Interferences (Boiler crane)

- Miscellaneous Issues

- Office trailer siting/hookups

- Crew work areas/break locations/restrooms

- Control of contract personnel

- Warehousing and Receiving Issues

- Subcontractor Insurance Paperwork

3. Engineering and Performance Discussion(~3 hrs.)

- Detailed Design Review

- Boiler Computer Model Detailed Review

- Boiler Performance Testing Procedures and Format

Overfire Air System Design Experience

Babcock Power Inc.

The boiler modifications designed by Babcock Power, Inc. (BPI) and installed by their sister company Thermal Engineering, Inc. during the recent Unit 1 outage included both the platen superheat extensions and the overfire air modifications. Due to the demanding nature of the design aspects of this project, the decision was made by IPSC Staff to include only those bidders with significant boiler and overfire air design experience.

BPI at the time this contract was established, was a wholly owned subsidiary of Duetsche Babcock. The same Duetsche Babcock that sold a franchise within the U.S. which has become Babcock & Wilcox. BPI is, for example, the current owner and supplier of the MPS pulverizer technology currently in service at IGS.

A large portion of the boiler design expertise within BPI comes from the well-known Riley Power Boilers company which BPI bought as they entered the U.S. market in order to provide a base of experienced boiler designers. Established in 1913, the Sanford Riley Stoker Company, (eventually Riley Power Boilers) was purchased by Duetsche Babcock in approximately 1990.

The attached experience was provided by BPI showing a portion of the overfire air installations they have designed and installed since approximately 1980. Of the 43 power plants (58 generating units) none are as large as Intermountain. The largest in this list is Homer City Unit 3 at 4,845,000 lbs/hr. (700 MW unit rating). Phone contact was made with eight (8) of the stations noted on the list as having the larger output. In all cases where individuals associated with the respective projects were still working for the named utility, a positive report was received.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross

Page 1 of 2

FROM: Dennis K. Killian

DATE: November 6, 2003

SUBJECT: Unit 2 Burner Contract Adders

We recommend a material upgrade, a modified flow diffuser design and an additional amount for upgrading the burner air flow instrumentation system within the Unit 2 Burner Replacement capital project. There is \$4,500,000 budgeted for this year for burner replacement and \$420,000 for scanner replacement. Both of these projects are being handled under the ABT Contract. The original ABT material contract was for \$2,449,660 and these adders will bring it to a total of \$2,566,480. The installation contract is yet to be awarded. The burner replacement project was justified with an 18 percent rate of return and a 0.9 year payback.

The successful bidder for the Unit 2 Burners (ABT) provided, within their bid offering, several alternate design options on which we have now concluded our evaluations. The adders shown on the attached requisition are as follows:

- Upgraded burner materials
- Independent coal flow diffuser
- Upgraded air flow instrumentation

Upgraded Burner Materials

ABT has proven to have an excellent record in eliminating burner deformation at all installations to-date. However, the IGS burners are slightly larger and will be exposed to somewhat higher heat flux than ABT has seen. The 253 MA material is our current choice in the most severe applications at the burner front. It has provided the best service of any alloy, including stainless. The approximate \$41K for upgrading to this material is a relatively small price to pay for a significant degree of component life assurance.

Independent Coal Flow Diffuser

The original design of the ABT burners included an in-built flow diffuser in the burner elbow. This assembly required all burner elbows to be shipped off-site for modification. In addition to concerns for the outage schedule, this would also have made the diffuser replacement procedure both complicated and expensive.

As we noted this to ABT they provided an alternative method of installing this required flow straightener in a removable design, totally separate from the burner elbow. This will eliminate concerns over trucking burner elbows across the country and will make maintenance of this wear item much more cost effective.

Upgraded Air Flow Instrumentation

After considerable evaluation, ABT chose to offer air flow instrumentation from Eastern Instruments Inc.(EI) that while technically sound, had relatively little experience in secondary air systems and absolutely no experience in burner applications.

We followed up with our own evaluation of both EI and the more established vendor Air Monitor, Inc. Air Monitor has notable experience in burner air systems. Also, we have purchased a significant number of the Air Monitor systems which are currently installed in the primary air flow at each pulverizer and throughout the new overfire air systems. We are recommending that the Air Monitor system be purchased with an increase in price of \$35,220.

Please note your approval to these contract changes by signing the attached requisition. If you have any further questions, please contact Jerry Hintze at ext. 6460.

JHN/JKH:jmg
Attachments

PART F - DETAILED SPECIFICATIONS

1.0 GENERAL

- 1.1 This section contains the equipment description, material and quality assurance requirements for burner nozzles purchased for Intermountain Generating Station.
- 1.2 The burner nozzles provided under this specification shall be designed and fabricated for interchangeable installation in place of any Intermountain Generating Station (IGS) Babcock and Wilcox (B&W) Dual Register Coal Burner.

2.0 MATERIALS

- 2.1 The nozzle shall be shipped with ceramic tiles and alloy tip fully installed. The deflectors and diffusers shall be shipped separately for installation at IGS. The windbox, sectioned seal plate, where provided by the nozzle manufacturer, shall also be shipped loose for attachment to the nozzle, following installation at IGS.
- 2.2 Nozzle material shall be in accordance with ASTM A53, A106, and all other applicable sections of the ASTM codes.
- 2.3 The nozzle shall be constructed as detailed on IPSC Drawing No. 98-15684-00 Rev. 1, Modified Burner Details and Assembly. Any discrepancies between this specification, the referenced codes and manufacturer standard practice shall be submitted to IPSC for clarification.
- 2.4 The flange and nozzle barrel shall be made of SA106 seamless steel, or SA53B seamless steel. The nozzle flange (upstream end of nozzle) shall be provided with 20 each 1-1/8" diameter holes equally spaced on 27-1/2 inch bolt circle. The flange shall be 1 inch thick plate of 30 inch O.D. by 22-3/4 inch I.D.
- 2.5 The ceramic lined portion of the nozzle shall be 4 feet long with a maximum outside diameter of 22-5/8 inches. The ceramic lining shall begin at the upstream nozzle flange and continue a distance of 4 feet downstream.
- 2.6 The surface of the installed ceramic lining shall be flush with the adjacent nozzle surface, true and even along the entire 4 foot length and well secured. The ceramic shall not be solely dependant upon an adhesive bond to the nozzle but shall be physically keyed in

position.

- 2.7 The nozzle tip shall be seamless material with no notches, valleys, or grooves. The nozzle shall be designed for continuous service in a flue gas environment up to 2000 Fahrenheit without incurring measurable creep or oxidation.
- 2.8 The diffusers and deflectors shall be B&W standard design DRB conical diffuser and deflector set fabricated of nitride bonded silicon carbide. Any deflectors and diffusers supplied shall be shipped loose. All fastener hardware necessary for deflector and diffuser installation shall be included with each nozzle.
- 2.9 Welding:
 - 2.9.1 Circumferential Nozzle Tip Weld (Dissimilar Metal Weld):
 - a. 100 percent penetration
 - b. Single V-groove weld, non-symmetrical bevels:
 - 1. 37-1/2 degrees on the alloy
 - 2. 60 degrees on the carbon steel
 - 3. 1/16 inch groove face, 1/16 inch groove space)
 - c. First pass shall be a Gas Tungsten Arc (TIG) weld with ENiCrFe-3 filler.
 - d. All other passes shall be SMAW with ERNiCrFe-3 rod.
 - 2.9.2 All nozzle welds shall have no cracks, lands, grooves, or ledges, and shall be blended/ground smooth to the nozzle wall.
- 2.10 The nozzle shall be straight and true throughout the entire length to within 1/8 inch. The nozzle shall be straight and true throughout the ceramic lined section to within 1/16 inch.
- 2.11 Windbox seal plate shall be shipped loose in two sections per nozzle plate. Seal plate shall be 3/8 inch thick, 22-3/4 inches I.D. by 28 inches O.D.. Seal plate shall be provided with 1/2" holes equally spaced on a 26" bolt circle at 45 degrees apart (8 total per seal plate).

3.0 QUALITY ASSURANCE

- 3.1 The vendor shall implement a Quality Assurance Program, complete with documentation verifying that each nozzle complies with the requirements of this specification. These documents shall be provided to the owner upon request.

3.2 The manufacturer shall maintain continuous contact with IPSC throughout the manufacturing process to allow for coordination of IPSC required quality assurance data and personnel visiting the manufacturer's facility.

4.0 SHIPPING

4.1 Nozzles shall be shipped banded securely to skids or pallets. Provision shall be made for efficient loading, unloading and handling of the nozzle and associated components.

4.2 The vendor shall guarantee the complete nozzle assembly, including diffuser, deflector and ceramic liner to be concentric and free from defects or damage upon delivery. Any damage occurring to the nozzle or associated components during manufacture or delivery shall be replaced by the vendor.

INTERMOUNTAIN POWER HISTORY

Burner Thermal Redesign

Summary:

Burner assembly degradation on Unit 1 advanced rapidly during the early years of commercial generation at Intermountain. This degradation was largely the result of original equipment manufacturer (OEM) recommended air flow settings and burner register design. Following in depth analysis and testing of burner design and operational parameters; improved combustion, fuel balancing and air flow distribution hardware was installed on U1 in 1991. Since these modifications Unit 1 burner hardware integrity has met all expectations.

History

Like all other major equipment at Intermountain, boiler windbox compartments receive a routine inspection by Engineering Services at all scheduled outages. Inspections completed during 1987-89 showed increasing levels of degradation resulting from severe thermal fatigue and creep mechanisms. Concerns had been expressed to the OEM regarding excessive temperatures around the inner burner sites when the corresponding mill was out-of-service. Out-of-service settings on compartment airflow dampers had been reduced to low levels by the OEM during acceptance testing of the boiler in order to achieve contract performance levels.

By 1990, degradation of burner assemblies on Unit 1 had advanced to point of inoperability on many burners, requiring hundreds of manhours each outage just to bring the deformed burners to an inefficient state of operability. Following the outages of 1990, redesign efforts began in earnest, to evaluate boiler operational parameters and to match a burner design with these parameters to achieve the required burner thermal resistance and design life.

With the assistance of RJM, Inc., a combustion design consultant, a burner design task force was established with IPSC and B&W, Inc. The resulting design included innovations for allowing thermal growth in the burner backplate, a serious weakness identified in the earlier burner design. Provisions were made to allow outer air register balancing with field installed banding. Additionally, air flow studies revealed the need to install air flow stabilizers at the exit of the inner air zones to ensure more stable combustion profiles and help protect vulnerable burner components.

Short of complete register replacement, many of the same corrections were made on the Unit 2 burners. Unit 2 burners were experiencing the same problems as Unit 1, but were at a less advanced state of degradation. With the improvements later made on Unit 2 burners, Unit 2 has performed satisfactorily to-date. Replacement of Unit 2 burners, based on current inspections, is still a matter of years away.

Burner integrity and operability, especially on Unit 1, have stabilized. Only a minor amount of repair is typically required each outage to maintain these burners in good condition. An average of four to six stabilizers are replaced on each unit, each major outage. IPSC has developed an in-house design for these stabilizers using more durable, but less expensive, metal incorporating rare earth additives. Instead of buying stabilizers on contract for \$2800 each, they are now built on-site for approximately \$350 each.

Intermountain Power Service Corporation

Pet Coke Users
Industry Survey

1. What range of grindability have you documented?
2. What percent of samples is sub 40 HGI? (Shot Coke)
3. What average percent sulfur, nickel and vanadium have been documented?
4. What percent volatiles have been documented?
5. How and how often do you check vanadium, nickel, HGI, sulfur and volatiles?
6. Have you ever experienced unstable flames or ignition associated with coke?
7. What was your pre-coke average carbon-in-ash? Current average carbon-in-ash?
8. Do your sources index the cost of coke based on HGI? Sulfur?
9. How do you receive shipment? Barge? Rail? Truck?
10. What estimated percent of your pet coke is +50 HGI? (Sponge Coke)
11. From what regions do you typically purchase your coke?
12. Has any Vanadium Pentaoxide related corrosion within your boiler been documented?
13. Has slagging or fouling increased since burning coke? (Furnace/Pendants/Backpass)
14. What % coke are you burning now? Future plans?
15. How much have you documented your coke chemistry to vary:
 - Sulfur?
 - Vanadium?
 - Nickel?
 - Volatiles?
 - HGI ?
16. Have you ever had trouble purchasing adequate tonnage?
17. Do you purchase your coke through a distributor(warehouser) or direct from the refineries?
18. Has capacity on your mills been affected on average? Fineness? Amps? Differential?
19. What type of blending system do you have? Do you experience slugs of coke?
20. Have you experienced buildup (sticking) on the tables or classifiers?
21. What adaptations/modifications have you implemented to accommodate SOx removal requirements?

- 22. Have you experienced any greater frequency of OOC incidents?
- 23. Do you or did you sell your ash to anyone?
- 24. Has the status of flyash sales changed since burning coke?
- 25. What maximum % coke do you feel you could productively and safely burn?

Techonomics Rotating Throats
Guaranteed Parameters

The following performance and maintenance parameters are the minimum guaranteed parameters defining acceptance or rejection of the Techonomics throats to be installed at the Intermountain Generating Station. The determination of acceptance or rejection will be made by Intermountain Power Service Corporation based on the testing and historical baseline data that IPSC determines to be most reliable and consistent. Any performance improvements specified in the following list shall be calculated as the difference between the existing B&W rotating throat performance and the Techonomics rotating throat performance.

1. Minimum guaranteed fineness..... 75%
(% passing 200 mesh corrected for moisture and HGI)
2. Maximum guaranteed drive system amperage at 95% feeder speed..... 62 amps
(under normal operating conditions)
3. Mill shall provide stable operation at full rated capacity (65 tph) regardless of rock content in fuel. Stable is defined as a maximum dp of 21", no coal bias, no air bias, no duct pressure bias.
4. Mill shall experience no measurable erosion in mill areas above the roll wheels.
5. Techonomics rotating throat life shall wear at one-half or less of the rate of the B&W rotating throats.
6. Mill shall not exceed 2" higher differential than the lowest running B&W rotating throat at any mill capacity.
7. Mill rejects shall consist of at least 70% noncombustibles.
(Visual inspection is not adequate to accurately determine actual pyrite content. Pyrite samples shall be washed and lab inspected.)
8. NO_x emissions shall not increase as a result of Techonomic throat installation.
9. Any throat components breaking or cracking under typical operating circumstances shall be replaced by Techonomics at no cost to IPSC for materials.
10. Mill will be operated at a maximum fuel to air ratio of 2:1 throughout the testing period.
11. Techonomics rotating throats shall not impede the removal of the gearbox and drive assembly beyond what is typically required with stationary throats.
12. Tests shall be run with a hydraulic loading skid discharge pressure of 2100 psi.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: Norm Mincer

FROM: Dennis Killian

DATE: March 6, 2001

SUBJECT: Construction Package for IGS00-20
Superheat and Reheat Sootblower Addition

Please prepare to assist in installation of the six (6) new sootblowers being installed in Unit 1. As agreed, IPSC installation labor on this project has been held to a minimum. We appreciate your willingness to install the waterwall panels.

Please create sub work orders to 00-84639-0 for completion of the maintenance portions of the work scope. Contact James Nelson at Extension 6464 with comments.

JHN/JKH:db

Intermountain Power Service Corporation

Overfire Air System Control Description

The general design of the Intermountain Generating Station combustion system originally included with eight compartmented burner plenums fed from a common combustion air duct on each side of the boiler. Dampers installed at each end of the compartmented burner plenums operate in a master/slave arrangement with both dampers moving to a pre-determined position to ensure balanced air-flow at each row, depending on operational status of the associated mill.

The addition of the overfire air system did not change the original operating strategy for air flow control at the burner rows. The compartmented burner plenums still admit air at each end of the burner rows through parallel operated (master/slave) dampers at each end of the individual plenums. The primary change to combustion control has been the installation of a control signal auto-bias capability that provided the capability during system startup tuning to increment down the air flow demand signal to the plenum dampers to re-direct the combustion air up into the overfire plenum that is now installed in parallel with the other burner plenums at the front and rear of the furnace.

The auto-biasing capability recently installed in the original burner plenum dampers is sufficient to redirect up to 20% of the combustion air to the overfire plenum. This modification allows for the dynamic control of combustion air requirements based on fuel demand to continue uninterrupted. Air flow metering was installed in the new overfire duct to provide direct indication of air flow into the overfire plenum. Flow indication at each, individual overfire port was also installed to provide both air flow balance and total overfire air flow confirmation.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross Page 1 of 2

FROM: Dennis K. Killian

DATE: October 15, 2003

SUBJECT: Response to Inquiry on Mitsui Babcock NO_x System

We were recently requested to investigate a new NO_x abatement system designed by Mitsui Babcock called NO_x Star. The NO_xStar system is similar in approach to the category of technology referred to as AEFLGR (Amine-Enhanced Fuel Lean Gas Reburn). It is an emerging design comparable in cost to SNCR (Selective Non-Catalytic Reduction) and other FGR (Flue Gas Reburn) technologies that we should observe carefully over the next few years.

The basic design of the NO_xStar system installed at the TVA's Kingston Power Plant consists of a set of low BTU burner lances mounted on the pendant tubes. A stream of ammonia-based reagent mixed with a small amount of natural gas is fed into a region of the upper boiler where flue gas temperatures are in the range of 1800°F. Upon combustion, this mixture produces a catalyst that reduces the ammonia and NO_x present in the flue gas into Nitrogen and water.

Discussions with Mr. Ron McNutt, Construction Manager at the Kingston Station, revealed that although the process produced an approximate 70 percent NO_x reduction as published in the Power Magazine article, difficulties in superheat steam temperature control and tube fouling were experienced during testing of this system. Mr. Jeff Littrell, Tech Services Manager and Project Engineer for the NO_xStar installation stated that the pilot system at the Kingston station experienced leaks in the water-cooled lances that caused subsequent failures in downstream boiler tubing. He commented that lance designs are being modified for steam cooling on the new system at Colbert Unit #4.

SCR (Selective Catalytic Reduction) technology is currently among the most effective of NO_x reduction alternatives with NO_x removals as high as 90 percent and an initial cost of \$50-\$70/kW. Although only installed in a single 200MW to-date the installed NO_xStar cost estimate, according to TVA personnel, is expected to be in the \$30/kW range. SNCR and Gas Reburn technologies are currently costing \$10-\$20/kW with NO_x removals as high as 60 percent.

IP12_003485

Operating costs for the various technologies occupy the same relative position as the first costs noted above. Operating costs for SCR technologies have been in the range of \$5,000,000 annually. SNCR, FGR, and NO_xStar Technologies are expected to be approximately half the SCR operating costs. Contact James Nelson at ext. 6464 with comments.

JHN/JKH:jmg

Pet Coke Test Burn

**Modified Burn Procedure
Beginning Saturday
12/04/99**

Section I:

At the time of this writing the Unit 1 Silos are essentially full of normal quality coal. It is estimated that this charge of coal will finish passing through the mill in the morning hours of Sunday 12/05/99. We request that a coal/coke blend of approximately 15% be placed in the silos behind the present charge.

During the night we request that the B mill be placed in service and the E mill be removed from service. We request that the E mill secondary air dampers be placed in manual and adjusted to achieve minimum NOx.

Section II:

Beginning early on Sunday 12/05/99 individuals from both Eng. Serv. and Radian will be on-site to monitor the 15% test burn. From the results of yesterdays pet coke burn, we anticipate that peak Nox will occur at least 6-8 hours after the start of pet coke consumption.

Approximately 4-6 hours into the consumption of coke Eng Serv will provide a recommendation to Operations as to the following charge of coal/coke to the silos.

Section III:

If performance parameters are stable during the 15% burn test, Operations has the option of continuing the test burn into the originally intended '20% by btu' test. If performance at the 15% coke level causes significant concerns, the test may be terminated as the remaining 15% charge is consumed. If the test is an unequivocal success we recommend that the coke % be increased to the originally intended 20% blend and continue with test burn until the coke and/or sodium formate is consumed.

15% blend

Plow D - approx. 132tph

Other Plow - approx. 888tph

20% blend

Plow D - approx. 176tph

Other Plow - approx. 824tph

Running History on Pet Coke Test Burn
Beginning Saturday 12/4/99

Problems Encountered through Saturday and Sunday include:

- Nox was originally running high, on at least one occasion exceeding .5 limit (Saturday)
- Scrubber So2 outlet number ran high most of Saturday
- SO2 not responding as expected to large additions of formate
- Scrubber Ph controls not able to run in auto above 500pm nor log in CEMS

Actions Taken

Saturday chose to put B mill back in service and remove E mill. Saturday night 12/4, ran unit without Coke to establish baseline Nox and Sox numbers.

Ran Coke to mills at approx. 13.6-15% beginning 7am Sunday morn. (Coke reached mills at that time). All day Sunday experienced B mill reliability problems. Emissions not stable most of Sunday.

Sunday night, following 8 tons formate in feed tank and 8 tons formate in reaction tanks, buffer numbers began to stabilize. Buffer numbers still showing dissipation without provocation (no addition of new limestone). Status of pretreatment addition in question.

2 bags added to feed tank @ 7:30 am and 8:30 am respectively. Then again at 10:30 am. Increased frequency of formate buffer testing in feed tank from 2/shift to 1 every other hour, then to 1/hour beginning at approximately 09:00 Monday morning, continuing through afternoon.

Formate buffer numbers were as follows:

09:00 Slurry Tank	164.3
10:00 " "	154.0
11:00 " "	171.1
12:00 " "	177.5
13:00 " "	194.0
13:00 U1 "A" Rx Tank	43.4
14:00 Slurry Tank	176.5
15:00 " "	192.5

Formate buffer numbers stopped their downward trend (without limestone addition) in the feed tank beginning approx. 11:00.

Formate numbers continued relatively stable without significant formate addition throughout the afternoon and evening. Formate added (2 bags) in early morning hours (approximately 02:00 Tuesday morning).

SO2 emissions holding stable at approximately 0.07, Nox emissions varying between .38-40. Percent removal approx. 94%. Has been considerably lower at times when upper compartment (e mill) opened for cooling air effects. However, LOI considerably worsened when E secondary air

dampers left open. Getting as high as 2.5.

January 4, 2011

Mr. Charles A. Steede
TEI, Inc.
5 Neponset Street
Worcester, MA 01606

Dear Mr. Steede:

Completion of Unit 1 Installation - Contract #03-45576

Per your request, we are providing this letter as an acknowledgment of the completion of the installation phase of Contract #03-45576 on Intermountain Unit 1. We would like to take this opportunity to congratulate those involved on a quality and a timely completion.

Also per the contract, we take this opportunity to provide formal notification to Babcock Power, Inc. (BPI) and TEI Construction Services, Inc. (TEI) of our approval to proceed with fabrication and installation preparations for Unit 2. The Unit 2 Outage is still scheduled to begin on February 28, 2004.

A project meeting with BPI and TEI individuals from the Unit 1 installation is scheduled for the week of April 28, 2003, to coincide with the contract boiler performance testing. Please ensure that the key individuals can attend this meeting to discuss concerns identified during the Unit 1 installation and suggestions for Unit 2. We request that Mr. Darrell Steede again be scheduled to serve as superintendent for the installation on Unit 2.

We specifically appreciate TEI's pro-active approach to safety programs and issues as well as the results-oriented work ethic. We have added TEI to our approved bidders list on several upcoming large projects including our Supplemental Maintenance Services Agreement (SMS). These bid packages will be provided for your completion and submittal as they are prepared.

Sincerely,

Dennis K. Killian
Superintendent of Technical Services

JHN/JKH:jmg

cc: Larry Boucher

IP12_003490

□ REQUISITION FOR CAPITAL EQUIPMENT

Purpose of Materials, Supplies or Services:

Replacement Pulverizer Rotating Throats

Account No. 001SGX-401
Work Order No. _____
Project No. _____

Delivery requested by [Date] 9/10/99 Originator James Nelson

User Survey
Techinomics Rotating Throats
8/25/99

1. Belle River, Unit 1

Mr. Doug Clyne, Pulverizer Engineer (810) 326-3333

- The Tech throats were installed in latter 1996
- They are the oldest running throats at the station.
- Fineness continues to be excellent with over 78% minus 200 mesh.
- The mill in which the Tech throats were installed is capable of full mill capacity burning PRB coal.
- Inlet temperatures are approx. 650 F, burner line temps are approx. 135 F
- The other pulverizeres in the unit are Tech stationary throats.
- Air to fuel ratio is consistently 1.9/1
- Rock rejects average 11 pounds per hour.
- LOIs average 0.24%
- Nox averages .28 lbs/MMBtu
- No detectable wear on the ledge covers after 30 months of operation.
- Of 16 existing mills:
 - 1 mill Tech CW rotating throats
 - 1 mill SAS CCW rotating throats
 - 14 mills Tech stationary throats
- No major concerns with SAS or Tech rotating throats
- Tech stationary throats last about 4 years. Tables and Tires last 5 years.
- Tech rotating throat mills running at least 5 amps lower than the fixed throats.
(Usually noted between 8-10 amps lower.)
- Fineness is at least 5% better than fixed throat.
- Had earlier style T-bar which wore out in about 1 year. Have since changed to chrome hardened design.

2. Hunter Power Plant, Unit 3

Mr. Steve Cha, Mill Foreman (435) 748-6541

- Installed in May 1998
- Replaced B&W rotating throats that constantly broke the segment attachment bolts.
- Tech Rts installed in 5 ea 10 hour shifts by three mechanics.
- During unit startup B&W biased mill PA flow down as far as possible for Nox
- All mills operating below 1.9/1 air to fuel ratio
- Mills handling 120,000 lbs/hr coal and excessive rock rejects.
- Rejects exceed handling system capacity.
- Rejects being handled manually

- Mills equipped with B&W phase II powered classifiers.
- Classifier speed is lower with the Technomics throats
- Wear rate is half the wear rate of the B&W rotating throats.
- Slight ledge cover wear at the top (sharper) point of the cover.
- Unit three has 4 B&W 89G mills, 2 ea with Tech Rts and 2 ea with B&W throats
- To increase throat life, Hunter installed B&W Rts which fell apart.
- Currently B&W throats are replaced with Technomics Rotating Throats.
- T-bar experienced significant wear in only 10 months (non-alloy style)
- After 13 months of operation tire mounts broke impacting ledge segment which broke off. Mill damage due to failure of mill components other than throats.
- What data has been taken show mill performance as "good". Specific data was not made available.

3. American Electric Power - Amos Station - Units 1 & 2

John Lester - Pulverizer Engineer - (304)768-0407

Unit 1, 1-1 mill

- Converted MBF23 mill with MPS 89 internals and grinding elements
- Had B&W Rts prior to conversion to Tech Rts .
- Was a problem mill located at the end of the PA duct. Even after overhaul and new B&W throats, never achieved better than 55-60% through 200 mesh and 96.4% through 50 mesh and a maximum capacity of 47.5 tph.
- Air to fuel was usually required at 3.0/1 and above and seldom in automatic.
- Mill was hard to control and often responded in unpredictable manner.
- Conversion to Tech Rts in Sept 1998 with no other maintenance work performed.
- After conversion: 77.36% through 200 and 99.8% through 50
- Capacity increased to 120,000 lbs/hr
- Air/Fuel consistently under 2.1/1
- Mill operates in automatic with 'excellent' to controls.
- Fineness consistently at least 10 points higher than other mills with B&W throats regardless of coal composition.

Unit 2, 2-1 Mill

- This mill is a duplicate of the 1-1 mill.
- Tech Rts installed in same time as first mill.
- Performance has exceeded the results of 1-1 mill
- Mill dp about the same
- Mill motor amps lower by 5 amps.
- No continuous monitoring in place
- Tech Rts perform noticeably better than either FW or B&W Rts.
- Rejects discharge line is 8"

4. US Generating, Brayton Point, Unit 3, Mills 31, 32, 33 and 35

Carlos Medina, Pulverizer Engineer, (508) 646-5300

John Fitzsimmons, Operations Supervisor, (508) 646-5230

- 4 of 5 mills converted to Tech Rts during 2 week outage in May 1999
- Finished 4 mills on staggered schedule in 8 days.
- Three man crew in each mill averaged 8 hours to install and align each throat
- Unit now runs on 4 mills where 5 were required historically, using B&W Rts.
- Now achieving 84% through 200 mesh, prior to conversion 67%
- Nox has dropped from .4 lbs/MMBTU to .34 lbs./MMBTU (15% improvement)
- Rejects have increased in non-combustibles.
- LOIs have improved from 10% to under 4%
- Rock is handled manually. 4 operators per bottom ash system
- Current at least 5 amps lower
- Air / Fuel Ratio improvement from over 4/1 to now under 2/1
- No cracks have ever occurred in the throats at this facility per Carlos and John
- Bus voltage for mill motors is 4160 volts. Like most other plants.
- Since going to AR500 rolled angle the T-bar has experienced little noticeable erosion.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross Page 1 of 2

FROM: Dennis K. Killian

DATE: November 4, 2003

SUBJECT: Recommendation to Reduce Unit 2 Platen Extensions

We recommend reducing the platen surface addition by approximately half, to 4 feet in length. After reviewing the impact of the platen extensions on Unit 1, recent operating requirements for temperature control, and the historical sensitivity of Unit 2, it is prudent to reduce the addition of platen surface.

We are currently at a final decision point on the exact magnitude of the platen extension surface additions for Unit 2. We have taken another close look at pre- and post-modification superheat attemperation flow, sootblowing patterns and frequencies, air flow practices, LOI and emission impacts, and known response characteristics in Unit 2. All indicators suggest that a less aggressive approach in Unit 2 is warranted.

The basis for the original design point of an additional eight feet of platen length was the marked drop in steam temperature in Unit 2 that was observed during 950MWg performance testing in May of 2002. Not only were the analysis and the models based on this particular unit operational parameters but we also don't want to ignore the anticipated decline in coal quality and the advantages of additional platen surface under these conditions.

Contractual design/performance testing flows were identified as 2.5 percent O₂ specifically to allow for operational latitude. We are finding that there is a preference to run more toward the 3.0 percent O₂ levels for, among other reasons, LOI improvements and inferred CO emissions (see recent report to UDAQ). With this relatively small increase in mass flow comes a significant boost in superheat temperature support.

It is apparent from recent operating modes that varying the platen cleanliness factor by just 0.1 to 0.2 in the platens can readily control attemperation spray flows by up to 100,000 lbs/hr on Unit 1. This effect appears to significantly outweigh the platen surface impact. However, we see no reason to push the surface addition beyond an additional 4 feet.

Combined with the recognized response of Unit 2 to superheat temperature production, the increased furnace sootblowing requirements, the attemperation requirements since the spring outage, the temperature stability and achievement of emissions goals on Unit 1, moderation of the platen surface addition appears reasonable. BPI, the boiler modifications designers have notified us today that this can be accomplished without impacting the outage if a decision is made immediately.

Please approve the platen surface reduction by signing below. If you have any questions or comments, please call James Nelson at ext. 6464.

George W. Cross
President and Chief Operations Officer

JHN:jmg

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: George W. Cross

FROM: Dennis K. Killian

DATE: January 4, 2011

SUBJECT: Items for Staff Approval
Boiler Modification On-site Work

Within the boiler modification on-site coordination meeting a number of action items were identified. The following items are those requiring staff notification and approval.

Eliminate Boiler External Washdown

We request approval to eliminate the boiler external washdown from the upcoming outage schedule. Both worker safety and productivity will benefit from this approach.

As the plans for furnace scaffold, over-fire air pre-fabrication work and platen extension material staging have developed it has become clear that boiler external washdown would cause a significant increase in accident potential and notably impede the boiler modification work schedule. Due to movement of material, staging and construction schedule requirements, even partial washdown appears to unreasonably compromise project safety and timely completion.

Siting Contractor Office Trailers

We request approval to site the boiler modification contractor trailers directly south of the GSB. We also recommend staging the boiler tubing and miscellaneous steel in the same area.

As the mobilization plan has taken shape it has become apparent that access to the Unit 1 Turbine Crane Bay would be best for productivity as well as a direct route to and from the construction gate. The Contractor's superintendent is confident that there is plenty of room between the GSB and the paved road for material laydown. The GSB HVAC contractor currently located in this area has told us that he will be essentially finished up by that time.

Temporary Facilities Located in Boiler Enclosure

We request approval to locate both portable toilets and a lunch area in the boiler enclosure. This will encourage productivity

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and allow for better control of the 100+ contract craftsmen.

The portable toilets will likely be concentrated on and around the 9th and 15th floors. Additionally, the contractor would like to build a plywood decked lunch area near the work area on the 15th floor. The contractor feels this will be a significant advantage in maximizing productivity of his crews.

Contact James Nelson X6464 with any questions.

JHN/JKH:

U2 Steam Generator Flame Scanner System Replacement

The new ABB SafeFlame® DFS Scanner System utilizes visible light fiber optic technology and is designed to monitor both the pulverized coal and class I oil lighters on the IGS opposed wall fired, low NOx combustion system. A single flame sensor monitors visible light spectra and analyzes the resulting signature to determine flame condition which is indicated both locally, at each burner group as well as at the SafeFlame DFS Scanner System Chassis located in the Unit 2 Relay Room.

This system is not dependant upon orientation concerns associated with the mirror sets on the previous Flamon scanners. The SafeFlame system converts the visible light energy in an electrical signal at the photocell located in each flame scanner head at each burner. The ABB SafeFlame scanner heads have been integrally designed into the new ABT burners with a 9° viewing angle head. Positioned approximately 10" behind the register vanes in the main combustion air zone of the burner, the head has ample view of both the oil ignitor flame and the main coal flame.

The scanner head, rated for 900°F operation, houses only a light collection lense. This lens is connected via fiberoptic cable to the aluminum housing located at the burner front plate. Within this housing is a converter card which takes the light signal and converts it to an electrical signal. This signal is routed to burner group specific enclosures located at each end of the each burner row. These boxes provide local indication of burner flame status. From these local boxes, the electrical signal is transmitted to the SafeFlame DFS chassis located in the Unit 2 Relay Room. The microprocessors located within the SafeFlame DFS chassis enclosures analyze the electrical analog signal 2000 times per second, measuring both flame intensity and flame flicker frequency. The measured values are continuously compared to preset trip points for proving flame.

Individual burner flame status is routed from the DFS chassis to the ABB control system on modbus serial 485 cable using 4 serial multiplexers (SMCS), where it is displayed on operator graphics. The flame proven output relays are also hardwired to the Bailey combustion control system for mill permissive logic and to the local junction box LED's on each burner level.

Operational Guidelines:

The FlameSafe scanner system requires approximately 6 scfm of cooling flow at 6 inches of pressure. Our existing scanner blowers are adequate for this service. Scanner blower trips for whatever reason must be investigated immediately to avoid scanner head and convertor card overheat. Max operating temp of the aluminum housing located at each burner is 205 degF, but prefer to see it kept below 140F.

If an oil flame is not proving, there are no adjustments to be made at scanner housing assembly at the burner front. Rotating the oil ignitor nozzle would likely be the most effective remedy as it will move a brighter portion of the ignitor flame into the field of view of the scanner. The flame proven setpoint values could be modified by I&C in the relay room amplifiers, if necessary.

There is a quartz glass window on front of the flame scanner head, inside of the windbox, to protect the fiberoptic lens. This glass could get dirty and require cleaning. I&C has constructed a light scanner calibration test box, which they can use to verify the proper operation of a scanner head. If an eyebrow covers the scanner tip, insertion of an airlance could help in clearing the scanner field of view.

Unit 2 Steam Generator Burner Replacement

The new burners installed in the Unit 2 Steam Generator during the 2004 spring outage are latest technology, low NO_x, dual-register, burners. They resemble, in both appearance and function, the older B&W burners they are replacing, with only a few differences. The primary improvements in the new burners are associated with an enhanced ability to adjust, balance and control the distribution of the air and fuel between and within each burner. The new burners are also designed to more capably withstand the rigorous conditions within the windbox.

Design Features:

In order to provide greater flexibility in accommodating our changing coal chemistry, tightening environmental controls and load profiles, the new burners are designed with individual air flow monitoring instrumentation. This instrumentation will display individual burner secondary air flow on a specifically prepared PI screen. These flows will be used during startup to optimize flame shape and color as well as address CO and UBC documented during initial tuning.

Thermocouples will be installed on the burners in the areas of greatest concern. These will read out on the same PI screen as the operators have seen in the past.

The forward sections of the burners are made of 253ma, the material recognized as the most thermally accommodating alloy available for use in burners. All components receiving direct radiant energy from the boiler are constructed of this material. Burner components semi-shielded from the radiant energy in the furnace are fabricated of stainless steel.

Unlike the old burners, adjustment and balance of secondary air flow in the new burners can be accomplished without affecting the angular momentum ('spin') at each burner. This allows us make adjustments for optimizing emissions without severely affecting flame stability and vice versa. Due to the extensive secondary air balancing concerns that have been identified within and between the windboxes for many years, the specification for the new burners included a requirement for a computational flow dynamic (CFD) model of the combustion air delivery system. From this model a baffle system tailored to our windbox geometries was developed. Along with greater burner adjustability, this baffle system will allow us to more effectively adjust to varying fuel, mill and load conditions by delivering a more uniform supply of combustion air to each burner.

Operational Guidelines:

The old burners had a temperature limitation of 1150°F. The new burners will have a limitation of 1600°F on the 'barrel' thermocouple and 2000°F on the forward section 'nozzle' thermocouple. In addition, these burners have been designed with a setback from the furnace to further limit the amount of radiant energy absorbed.

The burners are designed to operate at or below .33lb/MMBTU and 200ppm CO when operated at 115% stoichiometry, a coal of 11,500btu/lb, FC/VM=1.2, fuel bound nitrogen of 1.04 lbs/MMBTU and OFA ports closed.

Adjustments to burner combustion air can be made in three ways:

- Inner Air Sleeve
- Outer Registers
- Outer Air Sleeve

The inner air sleeve handle is located at 12:00 just above the coal nozzle on the windbox wall. This sleeve is actuated by pulling in or out. This adjustment should only be attempted by personnel trained specifically in burner tuning. The OEM recommends this sleeve NOT be moved following initial setup.

The outer registers are manipulated by two ratchet handles located at 9:00 and 3:00 approximately 2 feet to either side of the coal nozzle on the windbox wall. These registers may occasionally require adjustment but are not normally the first or best means of correcting combustion concerns. Because these registers affect the tangential and the axial velocity of the combustion air, they should not normally be moved. The OEM recommends that these registers NOT be moved following initial setup.

The outer air sleeve on the new ABT burner is actuated by a single ratchet handle located in the 12:00 position approximately 2 feet directly above the coal nozzle on the windbox wall. This sleeve will be the normal means of adjusting the burner based on fuel source changes or pulverizer status, etc. Adjustments should be made incrementally with careful monitoring of the associated flame.

Secondary Air Heater Modifications

Secondary Air Heaters 1A and 1B have been modified on Unit 2 during the current outage. Unit 1 Secondary Air Heaters are scheduled to be modified during the upcoming 2005 outage. The modifications include redesign of the rotor frame and replacement of the air heater element with a design proven at several sites to provide improved performance.

The existing air heater rotor element (heat transfer plate surface) is nearing the end of its useful life. The current state of the air heater surface is such that unless the element is replaced significant degradation resulting in unacceptable air heater differentials and compromised gas flow would result within 3 years.

The new air heater internals have been bid with performance guarantees and associated liquidated damages for non-compliance. The performance guarantees are as follows:

<u>Parameter</u>	<u>Performance Guarantee</u>
Air Entering Temperature	67°F
Air Leaving Temperature	698°F
Gas Entering Temperature	751°F
Gas Leaving Temperature	282°F (without leakage)
Gas Leaving Temperature	272°F (with leakage)
Average Cold End Temp.	175°F
Pressure Drop Air Side	3.50 inches w.g.
Pressure Drop Gas Side	5.65 inches w.g.
Hot End Differential	7.60 inches w.g.
Cold End Differential	16.75 inches w.g.

The new air heater design consists of two large (deep) layers of air heater element in place of the four shallower layers previously used. This modification will reduce restriction to gas and air flow and will allow for more effective cleaning with each blowing sequence. The OEM is in fact recommending a reduction in both cleaning pressures and frequencies.

The new design maintains essentially the same overall depth within the air heater rotor. The sealing system and associated hardware, therefore, remains unchanged. The single exception to that rule is the addition of seal clearance gages. These gages will be installed, (4 on the hot end of each secondary air heater and 2 on the cold end), in order to maintain a clear, on-line indication of the radial seal gap. Leakage through the air seals is a significant issue in maintaining boiler performance. The gages will allow us to minimize air heater leakage and maximize performance of the air heaters and the steam generator.

Operational Guidance

A brief writeup by from the OEM is attached which offers several points of operational guidance in maintaining optimal performance within the air heaters. Based on these recommendations Engineering Services is preparing an test program for staff approval that would increment down both the sootblowing pressure and frequencies with a goal of eventually blowing only once per

24hr shift at a pressure of approximately 130psi on the hot end and even less on the cold end. As always however, continuous blowing is recommended on startup.

The sector plate sealing system remains unchanged by these modifications. Engagement and operation of this system is the same as it has been previously.

Because of the increased thermal efficiency air heater gas outlet temperatures may drop below the previously established 300°F limit. With the several uprates that have occurred at IGS and the thermal cycle improvements implemented at the facility, we are anticipating that a minimum load of approximately 350MW will be required to maintain a consistent outlet temperature of 300°F. This should not be a significant issue on a base loaded unit such as ours.

MEMORANDUM

INTERMOUNTAIN POWER SERVICE CORPORATION

TO: S. Gale Chapman

Page 1 of 2

FROM: Dennis K. Killian

DATE: October 26, 2000

SUBJECT: Recommendation to Increase Maximum Flow of Feed Pumps

We recommend rescaling existing speed controls on the boiler feed pump turbines to allow operation up to 6000 rpm. This change will require 3 to 4 shifts per unit to complete. No other modifications are required. The anticipated benefit is an approximate 150,000 lbs/hr additional flow, per pump, when trying to save the unit during feed pump trip incidents.

Early this year, concurrence was received from Flowserve, Inc. (Byron-Jackson) for increasing boiler feed pump maximum operating speed from 5750 rpm to 6000 rpm. (See Fax attached dated Feb 16, 2000).

With this in hand we re-initiated discussions with GE Boiler Feed Pump Turbine Division where our feed pump turbines were designed. We found that this facility (Fitchburg, MA) and largely all the same people, are now a part of TurboCare, Inc.. We forwarded all the historical communications on the study performed by GE in 1993 and requested their assistance in clarifying one outstanding concern left unresolved by GE. Namely, the probable increase in horsepower associated with operating at 6000 rpm. Copies of GE's response in 1993 and Turbocare's recent response, are attached.

Turbocare is, of course, willing to perform a more in-depth study, for a fee, using specific design numbers. However, with the data, diagrams and graphs prepared by GE from the original 1993 study and with Turbocare's own familiarity with these turbines they are agreeing with the following:

- 1- The existing emergency governor trip range of 6262 rpm to 6388 rpm is acceptable. Therefore, emergency governor plunger modifications are not required.

Page 2 of 2

- 2- Operation of the turbine up to 6000 rpm is acceptable, but in no case should exceed 6600 rpm.

Pump curves suggest that up to 150,000 lbs/hr flow, per pump, can be achieved with this adjustment. This is of significant benefit on loss of one feed pump. With your approval we will proceed with preparing a package for rescaling the boiler feed pump turbine high speed stop controls during upcoming outages.

Contact James Nelson at Extension 6464 with questions or comments.

S. Gale Chapman
President and Chief Operation Officer

JHN/JKH:db
Attachment